



Project Summary

Large Building Radon Manual

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Since 1992, the U.S. Environmental Protection Agency (EPA) has worked with the State of Florida to evaluate the impact of heating, ventilation, and air conditioning (HVAC) systems on radon entry and mitigation in large buildings. This manual summarizes information on how building systems (especially the HVAC system) influence radon entry and can be used to mitigate a radon problem. Two chapters address the fundamentals of large building HVAC systems and the entry mechanisms for radon in large buildings. Another chapter reviews the different types of radon measurements and how to plan a deployment of instruments to obtain the desired results. A proposed diagnostic protocol for investigating a generic large building, based on the investigations made in the State of Florida and other places, is outlined. Another chapter summarizes mitigation results reported in previously cited papers and reviews some of the factors to consider in designing, installing, and evaluating the effectiveness of a mitigation system. The manual concludes with some recommended building design and operating practices for new-construction large buildings.

This Project Summary was developed by EPA's National Risk Management Research Laboratory's Air Pollution Prevention and Control Division, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back.)

Introduction

The U.S. EPA's Office of Research and Development's (ORD's) Indoor Environmental Management Branch (IEMB) has been involved with the evaluation of com-

mercial and public building HVAC systems for a number of years. Since 1992, they have worked with the State of Florida to develop, validate, and provide guidance for radon diagnostic procedures and mitigation strategies applicable to a variety of buildings. This effort has produced reports applicable to Florida buildings and conditions. This manual summarizes findings and reports of the work performed with the State of Florida and integrates it with other previous and current national work.

The target audience includes architects, engineers, building owners, operators, and maintenance staff. It was developed to assist such individuals to incorporate radon mitigation practices into building design, construction, operation, and maintenance. The evaluation of building ventilation dynamics, building air system balance (including leakage rates of typical residential, commercial, and public structures), and HVAC components and their effect to dilute radon and indoor air pollution is an example of the type of information this manual was written to communicate. The ultimate benefit of disseminating such information to both the above stated building professionals in the performance of their specific jobs or tasks and the public at large will be the improvement of indoor air quality (IAQ) and reduction of adverse health effects of radon and other indoor air contaminants.

Procedure

Many case studies of large buildings and their ventilation patterns and problems have been made over the years, especially in relatively recent times since indoor contaminants have been connected with phenomena such as "sick building syndrome." Many of these studies have been initiated by various federal agencies with an interest in investigating or solving

such problems. Some have had their bases in efforts prompted by activities of individual states, and a few have their origins in the private or commercial sector. A listing of all such reports that have sprung from these studies would be too exhaustive for the purposes of this manual. Therefore, only those that have a direct link to radon contamination and a few that are representative of IAQ issues in general were reviewed. Radon research sponsored by the EPA, especially radon measurement and mitigation in schools and other large buildings, were discussed. A few publications reporting on research conducted by the National Institute of Standards and Technology (NIST) and the U.S. Department of Energy (DOE) were also reviewed. Finally, research sponsored by state or private agencies, such as the California Healthy Building Study, the Florida Radon Research Program (FRRP), and some private companies, were reviewed and abstracted.

Discussion

This manual brings together information for a wide audience of building professionals on how building systems (especially the HVAC system) influence radon entry and can be used to mitigate a radon problem in large buildings. Because readers may vary in knowledge of details of

building practices, familiarity with radon, and involvement with correcting existing or potential problems relating to them, not everyone will want or need to read it cover to cover in the order presented. The fundamentals of large building air handling (AH) systems and the entry mechanisms for radon in large buildings are presented with descriptions of how HVAC system operations affect ventilation and pressure differentials which in turn affect indoor radon concentrations. The different types of radon measurements are reviewed for building professionals who may not be familiar with radon measurement technology.

In addition to the fundamentals of building systems that may affect radon entry and how to measure that effect, this manual also addresses how to diagnose the problem and offers some possible solutions in existing buildings. A protocol is given that starts with preliminary measurements, information, preparations, and visits that may be required, details, activities of a diagnostic visit, and lists resulting reports. Some mitigation options are suggested that may be included in a mitigation plan. Examples are given from the literature of mitigation strategies that have been found to be successful in other large building work. Some information on installing mitigation systems and making follow-up measurements is also given.

Conclusions and Recommendations

Exposure to elevated radon concentrations is one of a number of IAQ issues facing large building owners, managers, and tenants. This document reviews the fundamental systems and practices that may exacerbate such problems. It also presents an approach to examine, diagnose, and remedy the problems. Research has identified several possible avenues to reduce or eliminate radon from being an indoor health concern and often to improve other aspects of IAQ at the same time. The very building systems that could have been part of the problem can be used to be part of a solution. An entire section of the manual is devoted to giving some recommended building design and operating practices for new-construction large buildings that can provide cost-effective assurance that radon should not become a problem in the building or that will enable a quick and reliable solution if it does. The advantages of installing an active soil depressurization system as the foundation is being built, of ensuring that the building's structural barrier is sound in terms of resisting soil gas entry, and of designing and installing an HVAC system that will establish a pressure boundary to resist radon entry are discussed.

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The complete report, entitled "Large Building Radon Manual," (Order No. PB98-123995; Cost: \$25.00, subject to change) will be available only from:

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